

## X-ray Topographic Study of Lely Plate at Different Conditions

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Beamline(s): X19C

**Introduction:** Silicon Carbide has a unique combination of electronic and physical properties for fabricating a device, which operates at high temperature and high power at micro wave frequencies<sup>1</sup>. The band gap of single crystal 6H polytype SiC is 2.86 eV compared with 1.1 eV for Silicon and 1.4 eV for GaAs at 300 K. Since device performance is affected by defects, the characterization of defect structures in 6H SiC, with the view to feeding information back to crystal growth scientists to optimize the growth process for obtaining better structural quality, becomes of paramount importance. The physical vapor transport (PVT) and Lely method are the primary growth techniques. Although the Lely method has been used to grow 6H-SiC for many years the sizes of Lely plates are limited, and mainly they are used as seeds to grow larger crystal boules. In the present work Lely plates have been studied by using Synchrotron white beam topography. (SWBXT).

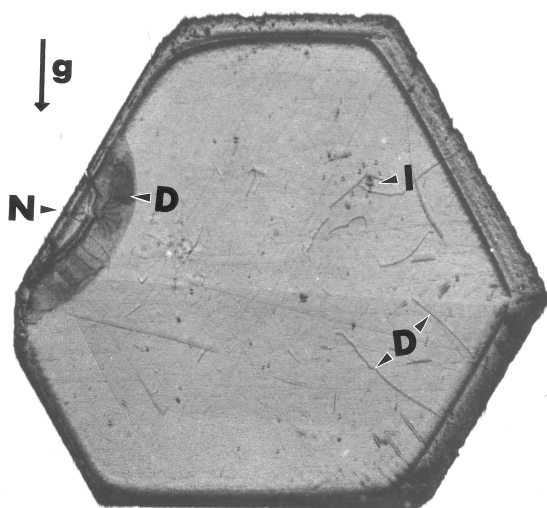
**Methods and Materials:** Topography was carried out on (0001) 6H-SiC platelets about 14 mm across and 0.5 mm thick supplied by M/S SiCrystal AG. These were green transparent platelets mechano-chemically polished on both sides. Crystals were examined under an optical microscope and found to be quite uniform except for minor scratches. Synchrotron white beam x-ray topography was carried out at Stony Brook Synchrotron Topography Facility, Beam line X19C, at National Light Source (NSLS), Brookhaven National Laboratory. The transmission Laue geometry was employed and the crystal was aligned such that (0001) plane was perpendicular to the incident white beam. All the six {10-11} asymmetrical reflections were recorded. Also similar topographs were recorded introducing a graphite plate to establish the feasibility for carrying out *in-situ* topographic characterization during growth.

**Results:** The topograph in fig 1. shows excellent overall perfection of the Lely plate. Only a few dislocations (D) running more or less perpendicular to the habit, and very less number of inclusions (I) are observed. These features are similar to any solution grown crystal. This high perfection is due to the fact that Lely plates are grown at extremely slow growth rates at essentially isothermal conditions. These crystals are spontaneously nucleated on the wall of the cavities and they are mechanically detached. In the figure, the edge where the nucleation (N) started can be observed. Also dislocations that were generated, near the nucleated region, by mechanical separation can be seen.

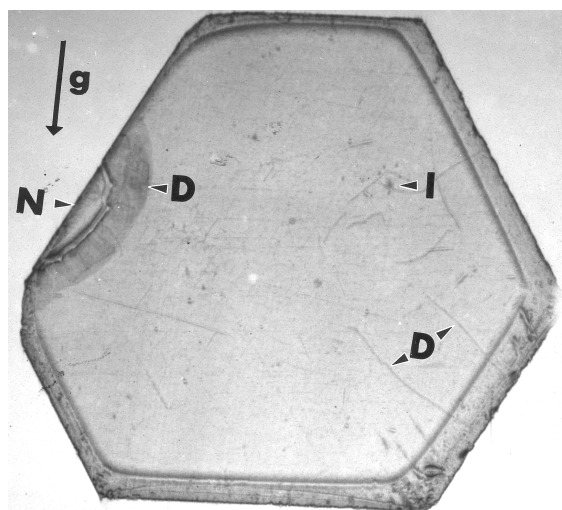
**Conclusions:** The topograph reveal the overall structural perfection of the Lely plate. The crystal contains only a few dislocations and inclusions as grown in defects. The topograph (Fig. 2) recorded keeping a graphite element in the path of the x-ray beam shows more or less all features as that of Fig. 1 with slight reduction in intensity due to absorption. This study establishes the feasibility for *in-situ* topographic characterization during SiC growth

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**References:** <sup>1</sup> J.W. Palmour, et al. in Amorphous and Crystalline Silicon Carbide 1V, Springer Proceedings in Physics, C.Y. Yang, M.M. Rahman and G.L. Harris, eds, 71, 66 (1992)



**Figure 1.** Topograph of (0001) Lely plate. (10-11) reflection.



**Figure 2.** Topograph of (0001) Lely plate with graphite element in the path of the x-ray beam. (10-11) reflection.